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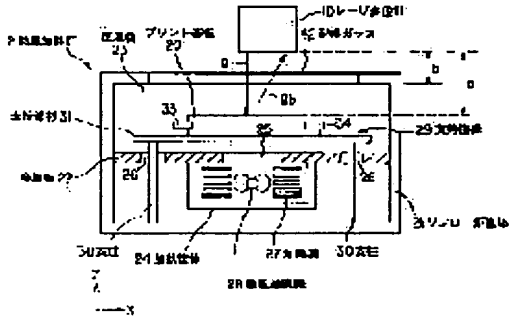
(54) HOT BLAST HEATER, AND WARP MEASURING DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a small-sized hot blast heater which can lessen installation area and can measure the warp of a printed board.
SOLUTION: The interior of a reflow furnace casing 21 for soldering an electronic part onto a printed board 20 by giving hot blast to this printed board 20 is divided above and below into the side of a heating casing 24 and the side of a thermostat vessel 23, and besides the heating casing 24 is provide at the bottom of a metallic plate 22.



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CLAIMS

[Claim(s)]
[Claim 1] Hot blast heating apparatus characterized by providing the source of heating established in the lower part in a furnace case, and the thermostat which performs predetermined processing to a processed object by the hot blast which is prepared in the upper part in said furnace case, and is sent from said source of heating.
[Claim 2] Hot blast heating apparatus according to claim 1 characterized by having had the metal plate which divides the inside of said furnace case into said upper part and said lower part, and establishing said source of heating in the lower part of this metal plate.
[Claim 3] Hot blast heating apparatus according to claim 1 characterized by having the support device which is established in the non-contact condition to said furnace case, and arranges said processed object in said thermostat.
[Claim 4] Said support device is hot blast heating apparatus according to claim 1 characterized by having the adjustment device of the height location of said processed object, parallelism, and an inclination.
[Claim 5] Two or more stanchions with which said support device was established from the lower part of said furnace case in said thermostat in the non-contact condition to said furnace case, The guide which consists of the quality of the material with a small coefficient of thermal expansion which is prepared on the supporter material supported in said thermostat, and this supporter material, and supports said processed object with these stanchions, Hot blast heating apparatus according to claim 1 characterized by having the adjustment device of the height location of said processed object prepared in this guide, parallelism, and an inclination.
[Claim 6] It is the hot blast heating apparatus according to claim 5 characterized by having formed said stanchion with molybdenum and forming said supporter material and said guide with the ceramics.
[Claim 7] In the curvature measuring device which measures the curvature of said processed object in the hot blast heating apparatus of a publication to either claim 1 which performs predetermined processing from the source of heating to a processed object by the hot blast sent thru/or among 6 The heat-resistant light transmission plate formed in the upper part of the furnace case in said hot blast heating apparatus, The non-contact-type displacement gage for measuring the curvature of said processed object through this light transmission plate, The 1st stage for being prepared in the location which counters through said hot blast heating apparatus, respectively, and moving said displacement gage to an one direction in the upper part of said hot blast heating apparatus, The curvature measuring device characterized by providing the 2nd stage for being prepared on this 1st stage, and it being perpendicular and also moving said displacement gage to a direction to said one direction.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the hot blast heating furnace which bundles up by hot blast and solders electronic parts on a printed circuit board, and the curvature measuring device which measures the curvature of the printed circuit board under processing within this hot blast heating furnace.
[0002]
[Description of the Prior Art] There is a mounting process by the surface mount which solders electronic parts on the surface of a printed circuit board. At this mounting process, melting of the solder is collectively carried out using the hot blast heating apparatus called a reflow furnace, and, generally the method which is stiffened next and mounts electronic parts is held.
[0003] By the way, as for the thickness of a printed circuit board, 0.6-0.8mm and a thin thing have appeared by miniaturization thin shape-ization of a product in recent years. Moreover, in order to begin to use the new approach of a build up method for a printed circuit board from the conventional subtractive method as the substrate manufacture approach and to realize lightweight-ization of a product, the ingredient of a printed circuit board has also been changing to various things.
[0004] In the reflow furnace, the problem that a printed circuit board will curve with reflow heating has arisen in the reasons of modification of the ingredient for such thin-shape-izing of a printed circuit board, and lightweight-izing, high-density-assembly-izing, etc.
[0005] On the other hand, while tending to enlarge for the formation of many pins, therefore the curvature of a printed circuit board becoming large and electronic parts' becoming easy to be influenced of the curvature of a printed circuit board at the time of mounting, the curvature of the electronic parts itself is also regarded as questionable.
[0006] Thus, since poor soldering which electronic parts shift from a printed circuit board, or falls when curvature occurs in a printed circuit board, and the curvature of a printed circuit board are large, it cannot include in a product, or the problem of residual stress reducing dependability has occurred.
[0007] Moreover, when soldering electronic parts collectively using a reflow furnace, in order to perform quality soldering, it is necessary to control a temperature profile. It becomes very difficult to get to know whether the printed circuit board is in what kind of condition in the opposite side of things with this sealing nature high [a reflow furnace] although sealing nature is highly excellent in adiathermic, and a furnace case, and although a temperature profile is controlled, it is impossible.
[0008] Furthermore, since the inside of a furnace case is heated by the temperature of 200 degrees C or more, it is also impossible to install the sensor for measuring the curvature of a printed circuit board. Although it is not necessary to seal the circumference of a printed circuit board if a printed circuit board is heated using a hot plate, it becomes that to which a heating method is different from a general hot blast heating reflow furnace, and credibility is low to the measurement result of the curvature of the soldering phenomenon in hot plate heating, or a printed circuit board.
[0009] Like the heat deformation measuring device indicated by JP,8-233543,A since it is such, there are some which measure serially the distance between the processed objects and displacement gages which covered the top face of a thermostat with the transparence plate, formed the displacement gage non-contact [optical] above this transparence plate, scanned this displacement gage in the two-dimensional flat surface, and were formed in the thermostat, and measure heat deformation of a processed object from that measurement result. With this equipment, the processed object has been arranged through a sample installation plate in a thermostat, the hot blast from the outside was supplied in the thermostat through the duct, the one direction was circulated, and it has discharged out of a thermostat through another duct again.

[0010] Moreover, measurement of heat deformation of a processed object installs the stage of the xy direction in the exterior of a thermostat, arranges a displacement gage above a thermostat through a displacement gage support fixture on this stage, and is measuring by moving a displacement gage to each lattice point of a rectangle field.
[0011]
[Problem(s) to be Solved by the Invention] However, in the thermostat of the above-mentioned heat deformation measuring device, the hot blast from the outside will be supplied in a thermostat through a duct, an one direction will be circulated within this thermostat, and the installation area of a thermostat will become large for the structure again discharged out of a thermostat through another duct.
[0012] Moreover, since measurement of heat deformation of a processed object installed the stage of the xy direction in the exterior of a thermostat and arranges the displacement gage above a thermostat through a displacement gage support fixture on this stage, the tooth space for installing the stage of the xy direction is needed besides the installation tooth space of a thermostat. For this reason, it will enlarge as the whole heat deformation measuring device.
[0013] Then, this invention aims at offering the hot blast heating apparatus which can make installation area small.
[0014] Moreover, this invention aims at offering the curvature measuring device which can measure the curvature of the processed object in a furnace case by miniaturization.
[0015]
[Means for Solving the Problem] This invention by claim 1 publication is the hot blast heating apparatus possessing the source of heating established in the lower part in a furnace case, and the thermostat which performs predetermined processing to a processed object by the hot blast which is prepared in the upper part in said furnace case, and is sent from said source of heating.
[0016] In hot blast heating apparatus according to claim 1, this invention by claim 2 publication is equipped with the metal plate which divides the inside of said furnace case into said upper part and said lower part, and establishes said source of heating in the lower part of this metal plate.
[0017] In hot blast heating apparatus according to claim 1, this invention by claim 3 publication is prepared in the non-contact condition to said furnace case, and is equipped with the support device which arranges said processed object in said thermostat.
[0018] Said support device is equipped with the adjustment device of the height location of said processed object, parallelism, and an inclination in hot blast heating apparatus according to claim 1 by this invention by claim 4 publication.
[0019] This invention by claim 5 publication is set to hot blast heating apparatus according to claim 1. Said support device Two or more stanchions prepared from the lower part of said furnace case in said thermostat in the non-contact condition to said furnace case, It is prepared on the supporter material supported in said thermostat with these stanchions, and this supporter material, and has the guide which consists of the quality of the material with a small coefficient of thermal expansion which supports said processed object, and the adjustment device of the height location of said processed object prepared in this guide, parallelism, and an inclination.
[0020] In hot blast heating apparatus according to claim 5, said stanchion is formed for this invention by claim 6 publication with molybdenum, and said supporter material and said guide are formed with the ceramics.
[0021] In the curvature measuring device which measures the curvature of said processed object in the hot blast heating apparatus of a publication to either claim 1 which performs predetermined processing to a processed object by the hot blast to which this invention by claim 7 publication is sent from the source of heating thru/or among 6 The heat-resistant light transmission plate formed in the upper part of the furnace case in said hot blast heating apparatus, The non-contact-type displacement gage for measuring the curvature of said processed object through this light transmission plate, The 1st stage for being prepared in the location which counters through said hot blast heating apparatus, respectively, and moving said displacement gage to an one direction in the upper part of said hot blast heating apparatus, It is a curvature measuring device possessing the 2nd stage for being prepared on this 1st stage, and it being perpendicular and also moving said displacement gage to a direction to said one direction.
[0022]
[Embodiment of the Invention] Hereafter, the gestalt of 1 operation of this invention is explained with reference to a drawing. Drawing 1 is the appearance block diagram of the curvature measuring device applied to hot blast heating apparatus and this equipment. On the base 1, the small reflow furnace 2 as hot

blast heating apparatus is formed. XY drive frame-common-equipment bases 3 and 4 are established in the both-sides side side of this small reflow furnace 2, respectively. These XY(s) drive frame-common-equipment bases 3 and 4 are formed in the rectangular parallelepiped of die length longer than the side-face die length of the small reflow furnace 2 more highly than the head-lining location of the small reflow furnace 2, respectively. Among these, while the Y-axis screw type stage (the 1st stage) 5 is established in XY drive frame-common-equipment base 3 in the upper part, the rail 6 is formed in XY drive frame-common-equipment base 4 on it at the upper part. The Y-axis screw type stage 5 connects screw 5b to the revolving shaft of motor 5a. These Y-axes screw type stage 5 and a rail 6 are mutually parallel, and are prepared in Y shaft orientations.

[0023] It is prepared in X shaft orientations so that the X-axis screw type stage (the 2nd stage) 7 may be constructed between these Y-axes screw type stage 5 and a rail 6. This X-axis screw type stage 7 connects screw 7b to the revolving shaft of motor 7a. This X-axis screw type stage 7, the Y-axis screw type stage 5, and in between, the screw by the side of the X-axis screw type stage 7 screws to the screw by the side of the Y-axis screw type stage 5, and the X-axis screw type stage 7 is moving them to Y shaft orientations by rotation of the screw by the side of the Y-axis screw type stage 5. Between the rail 6 and the X-axis screw type stage 7, the X-axis screw type stage 7 is moving the rail 6 top to Y shaft orientations through the rail mobile 8.

[0024] The displacement gage mobile 9 is formed in the X-axis screw type stage 7. Between these X-axes screw type stage 7 and the displacement gage mobile 9, the screw by the side of the displacement gage mobile 9 screws to the screw by the side of the X-axis screw type stage 7, and the displacement gage mobile 9 is moving it to X shaft orientations by rotation of the screw by the side of the X-axis screw type stage 7.

[0025] The laser displacement gage 10 is formed in the displacement gage mobile 9. This laser displacement gage 10 is for measuring the curvature of the printed circuit board as a processed object by which electronic parts are soldered to a package with heating in the small reflow furnace 2 by non-contact. This laser displacement gage 10 outputs a laser beam Qa, as shown in drawing 2 , receives the reflected light Qb from a printed circuit board 20, measures the variation rate of a certain point on the front face of a printed circuit board 20, and has the function which outputs that displacement measurement signal.

[0026] XY robot controller 11 carries out motion control of the Y-axis screw type stage 5 and the X-axis screw type stage 7 (XY robot) according to the program set up beforehand, and has the function to which the laser displacement gage 10 is moved on the flat surface of XY shaft in the upper part of the small reflow furnace 2. In this case, measuring range and its measurement pitch are set up by the command emitted from a computer 12, and XY robot controller 11 has the function which carries out motion control of the Y-axis screw type stage 5 and the X-axis screw type stage 7 according to these measuring range and a measurement pitch. In addition, setting modification to arbitration is possible for the measuring range and its measurement pitch of the laser displacement gage 10 by which an input setup is carried out to a computer 12.

[0027] The laser displacement gage controller 13 carries out motion control of the laser displacement gage 10, and has the function to send the displacement measurement signal outputted from the laser displacement gage 10 to a computer 12.

[0028] While a computer 12 receives the migration coordinate of the laser displacement gage 10 from XY robot controller 11, the displacement measurement signal outputted from the laser displacement gage 10 is incorporated through the laser displacement gage controller 13, the migration coordinate and displacement measurement signal of these laser displacement gage 10 are made to correspond, the curvature of a printed circuit board is measured, and it has the function which displays the measurement result on monitor display 14.

[0029] As shown in structural drawing of drawing 2 , the above-mentioned small reflow furnace 2 heats the solder on a printed circuit board 20 by hot blast, although electronic parts are soldered to the front face of a printed circuit board 20, remelts it in package, it is stiffened next, and makes electronic parts mount on a printed circuit board 20 in the mounting process which performs the surface mount of a printed circuit board.

[0030] This small reflow furnace 2 has become possible [setting temperature and time amount as four steps], and can be changing the heating conditions of a printed circuit board 20 to arbitration.

[0031] In the reflow furnace case 21, the metal plate 22 is formed in the middle height location at the longitudinal direction. This metal plate 22 insulated the inside of the reflow furnace case 21 in the upper part and the lower part, formed thermostat side 23 in the upper part, and has formed the heating case 24 in the lower part. While the hole 25 for hot blast circulation is formed in that center section, two or more holes 26 for stanchions are formed in the perimeter at this metal plate 22.

[0032] The heating case 24 is formed in the inferior surface of tongue of the hole 25 for hot blast circulation in a metal plate 22. In this heating case 24, the source 27 of heating and the hot blast blowers 28, such as a heater, are formed. The hot blast blower 28 ventilates into the thermostat 23 in the reflow furnace case 21 by making into hot blast Ayr heated in the source 27 of heating.
[0033] From the inferior-surface-of-tongue side of the reflow furnace case 21, four stanchions 30 which constitute the support device 29 as shown in drawing 3 are set up. Even if heat deformation of a case comes, these stanchions 30 joined the stanchion and the case, and although you may set up from the lower part of the exterior of the reflow furnace case 21 in the state of non-contact to the reflow furnace case 21, since it holds only by dashing, deformation of a support device was preventing from occurring and they have realized the miniaturization by this. These stanchions 30 have projected through the hole 26 for each struts formed in the metal plate 22, respectively in the thermostat 23 by the side of the top face of a metal plate 22. In addition, the hole 26 for each struts is formed in the slightly larger path than the path of each strut 30. Moreover, since it is easy to process each strut 30, it is formed with molybdenum.
[0034] It is prepared in the upper part of these stanchions 30 so that the tabular supporter material 31 may be carried. This supporter material 31 is formed with the ceramics. At this supporter material 31, each long holes 32a-32d for adjustment are formed in X shaft orientations at four places. The rod-like guide 33 is formed in each long holes 32a and 32b for adjustment at Y shaft orientations among the long holes 32a-32d for these adjustments, and the rod-like guide 34 is formed in each long holes 32c and 32d for adjustment at Y shaft orientations. These guides 33 and 34 support a printed circuit board 20, and are formed for example, with the ceramic ingredient with a small coefficient of thermal expansion of a under [heating]. And on these guides 33 and 34, the adjustment device (the following, height, and inclination adjustment device) 35 of the height location of a printed circuit board 20, parallelism, and an inclination is established, respectively.
[0035] Drawing 4 is the block diagram of height and the inclination adjustment device 35. The 1st height adjustment member 36 is bound tight with the nut 38 through the flat washer 37 by the supporter material 31. Stop section 36c to form a nut 38 and screw section 36a to screw in one side, and form hole 36b for a screw lump in another side, and for this 1st height adjustment member 36 stop to the supporter material 31 is formed. Moreover, the 2nd height adjustment member 39 is bound tight by the guide 33 through the flat washer 40 and the ring E 41. Screw section 39a which screws this 2nd height adjustment member 39 in one side to hole 36b for a screw lump of the 1st height adjustment member 36 is formed.
[0036] Therefore, the 2nd height adjustment member 39 has carried out vertical migration by rotating the 2nd height adjustment member 39 at Z shaft orientations by screwing with screw section 39a and hole 36b for a screw lump.
[0037] The heat-resisting glass 42 which is a heat-resistant light transmission plate is formed in the top face of the above-mentioned reflow furnace case 21. The magnitude of this heat-resisting glass 42 is extent whose whole surface of a printed circuit board 20 can be seen from the upper part 10 of the reflow furnace case 21, i.e., a laser displacement gage.
[0038] Here, the physical relationship of the laser displacement gage 10 and a printed circuit board 20 is explained with reference to drawing 2 . In order to protect the laser displacement gage 10 from heat like the above and to perform temperature control in the furnace of the small reflow furnace case 21 with high precision, measurement of the curvature of a printed circuit board 20 is performed through heat-resisting glass 42. The distance a of the laser displacement gage 10 and a printed circuit board 20 is set as 80mm**15mm. The distance b from the inferior surface of tongue of heat-resisting glass 42 to a printed circuit board 20 is set as 15mm or more. It is because the measurable range of the laser displacement gage 10 is 80mm**15mm, so the location of this heat-resisting glass 42 will be measured rather than a printed circuit board 20 within the limits of it if heat-resisting glass 42 is in a location nearer than the laser displacement gage 10.
[0039] Next, an operation of the constituted equipment is explained like the above.
[0040] In the reflow furnace case 21 of the small reflow furnace 2, a printed circuit board 20 is laid on each guide 33 and 34. In addition, these guides 33 and 34 move along with each long holes 32a-32d for adjustment according to the magnitude of a printed circuit board 20, respectively, and spacing between these guides 33 and 34 is adjusted.
[0041] Moreover, since four height and the inclination adjustment devices 35 are formed in these guides 33 and 34 By rotating the 2nd height adjustment member 39 in these height and the inclination adjustment device 35, Z shaft orientations are made to carry out vertical migration of the 2nd height adjustment member 39 by screwing with screw section 39a and hole 36b for a screw lump, and the height location, the

parallelism, and the inclination of Z shaft orientations of a printed circuit board 20 are adjusted. By adjustment, the distance a of the laser displacement gage 10 and a printed circuit board 20 is set as 80mm**15mm for the height location and parallelism of such a printed circuit board 20, and the distance b from the inferior surface of tongue of heat-resisting glass 42 to a printed circuit board 20 is set as 15mm or more.

[0042] After installation of a printed circuit board 20 is completed, while the energization to the source 27 of heating is started, operation of the hot blast blower 28 is started. By the hot blast blower 28, Ayr heated by the source 27 of heating serves as hot blast from the heating case 24, is ventilated, and is sent to the upper thermostat 23 of the heating case 24 through the hole 25 for hot blast circulation.

[0043] It is sent to a printed circuit board heating side. In this case, in the temperature and time amount in the reflow furnace case 21, the small reflow furnace 2 is set as the phase of arbitration, while of four steps, and it is changed to arbitration in the heating conditions of a printed circuit board 20. Within the upper thermostat 23, temperature becomes 200 degrees C or more, and temperature is in this condition from the metal plate 11 with ordinary temperature low by the downward heating case 24 side rather than the metal plate 11.

[0044] During heating to such a printed circuit board 20, since each guides 33 and 34 are formed with the ceramics, its thermal expansion is small. Moreover, since each strut 30 is set up by the exterior of the reflow furnace case 21 near ordinary temperature through the hole 26 for each struts of the metal plate 22 which insulates the thermostat 23 and heating case 24 side, its effect of the thermal expansion of a body to each guides 33 and 34 has decreased.

[0045] If it is in such a heating condition, the solder on the printed circuit board 20 which performs a surface mount in a thermostat 23 can be heated by hot blast, and can carry out remelting in package. Then, electronic parts are made to mount on a printed circuit board 20 by stiffening the solder on a printed circuit board 20.

[0046] On the other hand, during heating to a printed circuit board 20, XY robot controller 11 carries out motion control of the Y-axis screw type stage 5 and the X-axis screw type stage 7 according to the program set up beforehand, and moves the laser displacement gage 10 on XY flat surface in the upper part of the small reflow furnace 2. That is, by actuation of the Y-axis screw type stage 5, the X-axis screw type stage 7 which appears on this Y-axis screw type stage 5 and rail 6 moves to Y shaft orientations, the displacement gage mobile 9 which appears on the X-axis screw type stage 7 of a parenthesis moves to X shaft orientations, and the laser displacement gage 10 is moved on XY flat surface in the upper part of the small reflow furnace 2.

[0047] In this case, XY robot controller 11 carries out motion control of the Y-axis screw type stage 5 and the X-axis screw type stage 7 to a computer 12 according to the measuring range and its measurement pitch of the arbitration by which an input setup was carried out. Drawing 5 is the mimetic diagram of measuring range and its measurement pitch.

[0048] Moreover, XY robot controller 11 carries out migration control of the laser displacement gage 10 all over a printed circuit board 20 like two or more point of measurement S1, S2, S3, --, S11 and the measurement path of --, as shown in drawing 6 . If it is this measurement path, it is formed on a printed circuit board 20, and a hole 50 and a slit 51 can be avoided. Moreover, the thing of S20, S21, S22, and -- made to move to the point of measurement of the arbitration of a printed circuit board 20 like a measurement path is also possible from point of measurement S1.

[0049] Thus, while the laser displacement gage 10 moves to each point of measurement, this laser displacement gage 10 outputs a laser beam Qa to a printed circuit board 20 by the motion control by the laser displacement gage controller 13, and it receives the reflected light Qb from a printed circuit board 20, measures the variation rate of a certain point on the front face of a printed circuit board 20, and outputs that displacement measurement signal.

[0050] It incorporates the displacement measurement signal outputted from the laser displacement gage 10 through the laser displacement gage controller 13, a computer 12 makes the migration coordinate and displacement measurement signal of these laser displacement gage 10 correspond, measures the curvature of a printed circuit board 20, and displays the measurement result on monitor display 14 while it receives the migration coordinate of the laser displacement gage 10 from XY robot controller 11.

[0051] Thus, hot blast is given to a printed circuit board 20 in the gestalt of top Norikazu operation. Since the inside of the reflow furnace case 21 for soldering electronic parts on this printed circuit board 20 was divided into the heating case 24 and thermostat 23 side up and down with the metal plate 22 and the heating case 24 was formed in the inferior surface of tongue of a metal plate 22 As compared with the case where

the heating case 24 and a thermostat 23 are formed as respectively separate equipment, and the case where these heating case 24 and a thermostat 23 are installed in a longitudinal direction side by side, installation area of the small reflow furnace 2 can be made small.

[0052] Moreover, since it was made to lay in the small reflow furnace 2 in support of a printed circuit board 20 on the guide 33 of two, and 34, hot blast heating of the printed circuit board 20 can be carried out in the condition near actual reflow conditions.

[0053] Moreover, since each height and inclination adjustment device 35 are formed in the guides 33 and 34 of two, respectively, according to the height of a printed circuit board 20, a printed circuit board 20 can be installed within the limits of [measurable] the optimal location (from the laser displacement gage 10 to 80mm**15mm) 10, for example, a laser displacement gage. Furthermore, since the parallelism and the inclination of a printed circuit board 20 can be adjusted, after adjusting and minimizing parallelism mechanically in advance, the curvature of a printed circuit board 20 can be measured, and the whole equipment can be made cheap. In addition, the software which adjusts the data of the curvature measured and acquired whenever [concurrency] by two-dimensional is expensive. If the data of curvature are processed with software and parallelism adjustment is moreover carried out, an error will arise to an actual value, but if parallelism is adjusted mechanically in advance, highly precise measurement will be attained.

[0054] Moreover, since four stanchions 30 are set up by the reflow furnace case 21 in the state of non-contact from the lower part of the exterior of the reflow furnace case 21, they stop easily being influenced of the heat deformation by the hot blast in the small reflow furnace 2.

[0055] Moreover, an X-axis screw type stage is prepared on the Y-axis screw type stage 5 and a rail 6. Since the laser displacement gage 10 is formed through the displacement gage mobile 9 on this X-axis screw type stage 7, the motor for a drive of this laser displacement gage 10 is united with laser and it was made to make it move in the upper part of the small reflow furnace 2 The magnitude of the whole curvature measuring device applied to the small reflow furnace 2 and this reflow furnace 2 can be miniaturized. For example, the stage of the xy direction is installed in the exterior of a thermostat as indicated by above-mentioned JP,8-233543,A, with the configuration which arranges a displacement gage above a thermostat through a displacement gage support fixture on this stage, the die length according to the magnitude of the processed object in a thermostat is needed in a stage, and the magnitude of the whole equipment becomes large.

[0056] Moreover, since it was made to carry out motion control so that the measuring point of arbitration might be made to move the Y-axis screw type stage 5 and the X-axis screw type stage 7 to a computer 12 by carrying out an input setup of the coordinate of arbitration by XY robot controller 11, even if parts which cannot be measured, such as a hole 50 and a slit 51, are on a printed circuit board 20, parts, such as these holes 50 and a slit 51, are avoided, and measurement of the curvature of a printed circuit board 20 can be performed. In this case, in measurement of the substrate which has a hole 50, a slit 51, etc., since a migration setup can be simply carried out in other locations so that measurement in this part may not be performed, it becomes difficult to avoid the part which cannot be measured. Furthermore, it is effective in measuring the curvature of processed objects, such as two or more printed circuit boards 20, to coincidence.

[0057] furthermore, heat-resisting glass 42 is formed in the small reflow furnace 2, and the laser non-contact-type displacement gage 10 is moved by actuation of the Y-axis screw type stage 5 and the X-axis screw type stage 7 -- making -- since the curvature of a printed circuit board 20 was measured through ********** 42, the configuration and its amount of curvatures of curvature of the printed circuit board 20 by hot blast heating near actual reflow conditions can be measured quantitatively. Moreover, the configuration and its amount of curvatures of curvature of the electronic parts which the curvature of a printed circuit board 20 does not restrict, but are mounted in a printed circuit board 20 can also be measured to coincidence. Since the configuration and its amount of curvatures of these curvatures are measured with hot blast heating near actual reflow conditions, its credibility is high.

[0058] Thus, since the configuration and its amount of curvatures of curvature of the printed circuit board 20 under reflow heating or electronic parts can measure quantitatively, a design, the design of the printed circuit board 3 which took manufacturability into consideration in the prototype phase, and implementation of a mounting process are possible. That is, a design and defective pair policy of the high printed circuit board 20 of manufacturability are made.

[0059] In recent years by therefore, the reasons of modification of the ingredient for thin-shape-izing of a printed circuit board 20, and lightweight-izing, high-density-assembly-izing, etc. While the curvature by reflow heating of a printed circuit board 20 has been a problem, being in the inclination enlarged since electronic parts are many pin-ization, therefore becoming easy to be influenced of the curvature of a printed circuit board 20 In the present condition that the curvature of electronic-parts 20 itself is also regarded as

questionable, the configuration and its amount of curvatures of curvature of a printed circuit board 20 or electronic parts can be measured with hot blast heating near actual reflow conditions. The problem of that it cannot ** by the ability incorporating, the residual stress to the product for the curvature of the fall from the printed circuit board 20 of the electronic parts by curvature generating of a printed circuit board 20, poor soldering, and a printed circuit board 20 being large reducing dependability can be prevented.

[0060] Moreover, since each guides 33 and 34 are formed with the ceramics, also in heating to a printed circuit board 20, the thermal expansion can be performed small and they can make high curvature measuring accuracy of a printed circuit board 20.

[0061] Since each strut 30 is formed with molybdenum, this molybdenum is [that it is easy to process it] effective in forming the large-sized stanchion 30 cheaply.

[0062] In addition, this invention is not limited to the gestalt of the 1 above-mentioned implementation, and may deform as follows.

[0063] the gestalt of the 1 above-mentioned implementation for example, -- mounting -- although the case where it applied to measurement of the curvature configuration of the printed circuit board 20 which exists in process, or the electronic parts mounted, and its amount was explained, it cannot be overemphasized that it is applicable to measurement of the curvature configuration when giving hot blast to various kinds of processed objects and its amount.

[0064] Moreover, each strut 30 forms each hole in the inferior surface of tongue and the base 1 of the reflow furnace case 21, and you may make it lay it underground in the earth directly through these holes.

[0065]

[Effect of the Invention] As a full account was given above, according to this invention, the hot blast heating apparatus which can make installation area small can be offered.

[0066] Moreover, according to this invention, the curvature measuring device which can measure the curvature of the processed object in a furnace case by miniaturization can be offered.

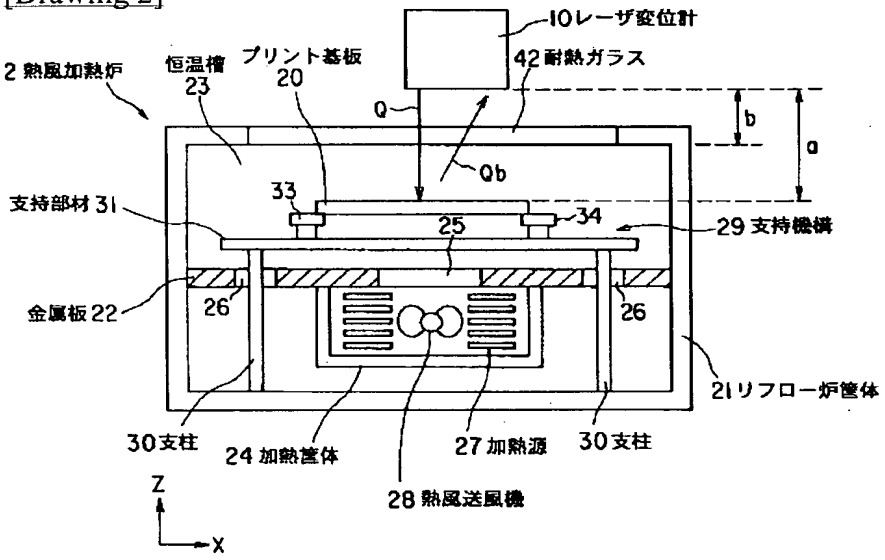
[Translation done.]

* NOTICES *

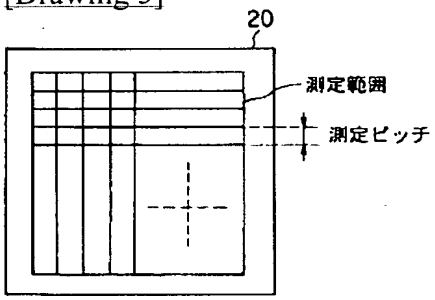
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

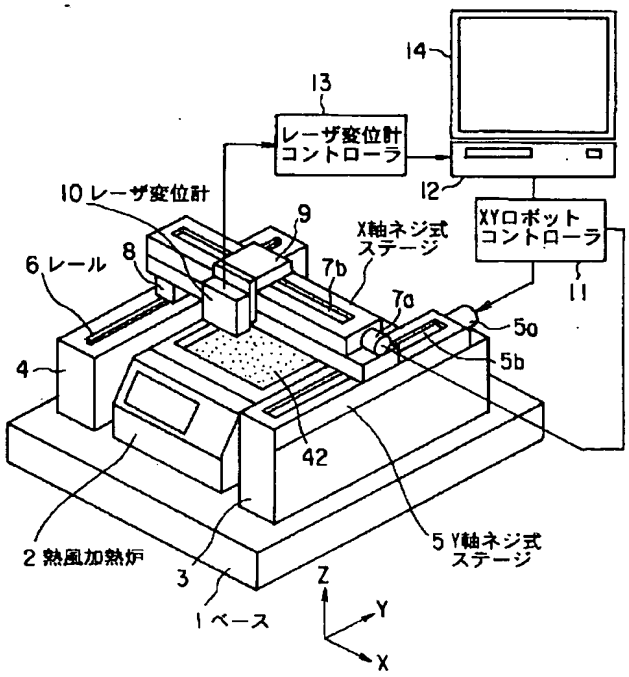
[Drawing 2]



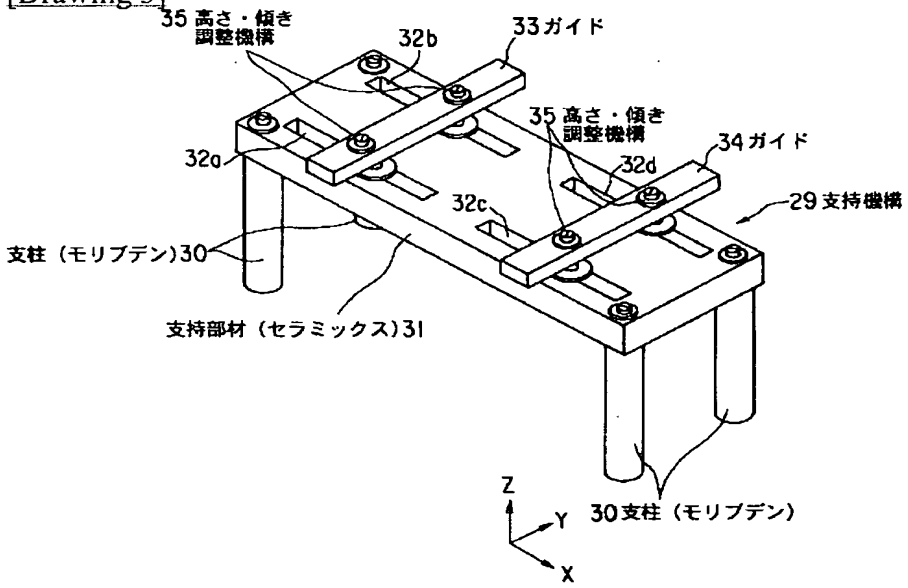
[Drawing 5]



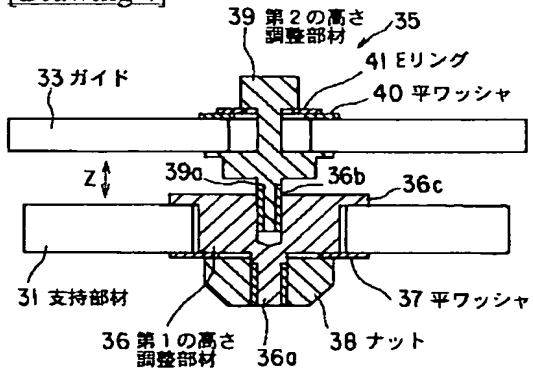
[Drawing 1]



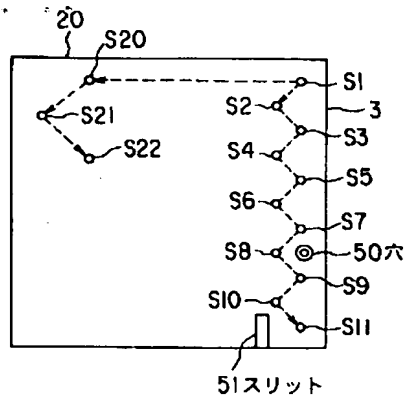
[Drawing 3]



[Drawing 4]



[Drawing 6]



[Translation done.]